Immunological Effects In Mink Chronically Exposed To A Commercial PBDE Formulation.

Pamela A. Martin[1], Greg J. Mayne[1], Steven Bursian[2], Jon Martin[3], Judit Smits[4]
[1]Environment Canada, Burlington, ON, Canada
[2]Michigan State University, East Lansing, MI, USA
[3]University of Alberta, Edmonton, AB, Canada
[4]University of Saskatchewan, Saskatoon, SK, Canada

Introduction

Polybrominated diphenyl ethers (PBDEs) are persistent, bioaccumulative, organohalogen compounds that are increasing exponentially in the Great Lakes biota. There is evidence that exposure to PBDE modulates immune system function and the structure of immune organs in laboratory rodents [16-18]. Currently, the immunological effects of PBDEs on aquatic mammals feeding at the top of the Great Lakes food chain are unknown. Wild mink (*Mustela vison*) may be at particular risk, as approximately half of their diet is composed of fish [10]. Mink are widely distributed in temperate North America and are found in environments close to urbanization, further increasing their risk of exposure to PBDEs originating from sewage effluents. Mink are sensitive to the structurally related organohalogenated compounds such as PCBs, dioxins, and furans [11-15]. Because of the abovementioned characteristics, and the fact that they are amenable to captive rearing, ranch mink serve as a useful model and a surrogate for their feral counterparts in testing for immunotoxicity of PBDE congeners and mixtures. The present study was undertaken to examine the immunological effects of a commercial PBDE mixture (DE-71) in ranch mink.

Methods and Materials

Female mink were exposed to 0, 0.1, 0.5, or 2.5 ppm of dietary DE-71 throughout breeding, gestation and lactation; weaned juveniles were exposed till 27 weeks old. Antibodies specific to keyhole limpet hemocyanin conjugated to dinitrophenol (DNP-KLH) were measured in juvenile mink at 25, 47 and 59 days following a challenge with the antigen. Organs were weighed and spleens, thymi and adrenals were examined histologically in 6-week old kits and 27-week old juveniles. Relative numbers of white blood cells were quantified.

Results and Discussion

Females from the 2.5 ppm group produced no surviving offspring. In adrenals, both cortical lymphocyte density and the prevalence of tingible body macrophages were reduced with increasing PBDE exposure and cortical cell hyperplasia was more prevalent in treated individuals than in controls. In spleens, the number and mean diameter of germinal centers was higher in the PBDE-exposed groups than in the controls (Fig 1), indicating an increased development of the B-dependant white pulp. Further, the mean number of periarteliolar lymphatic sheaths decreased with increasing PBDE exposure, indicating reduced T-dependant white pulp development. Development of germinal centers in spleen suggests juvenile and adult mink exposed to DE-71 may be mounting an inappropriate immune response.

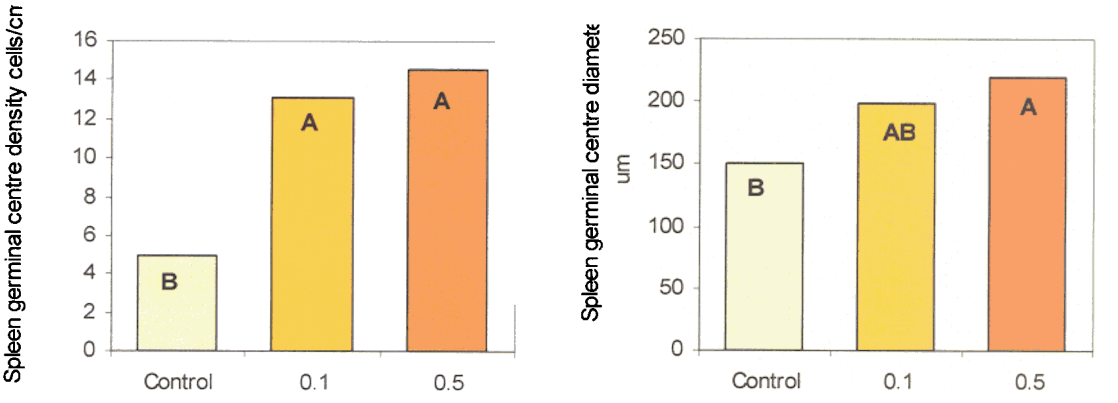

Figure Development of germinal centers in spleens of juvenile mink exposed to DE-71

The percentage of eosinophils in the blood tended to be lower in the high treatment group, relative to the control and low treatment groups, additionally the increase in eosinophils between the pre and post-dose measurement was smaller for the high treatment group.

All animals mounted a humoral immune response to the DNP-KLH challenge. Animals dosed with 0.5 ppm DE-71 showed a reduced KLH antibody response compared to control and 0.1 ppm mink (Fig. 2). The peak response was not decline in a similar fashion to the control and 0.1 ppm groups, resulting in a significant dose*time interaction.

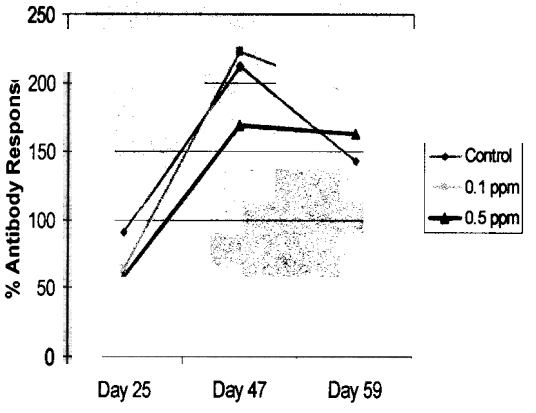

Figure 2. Antibody response following challenge with DNP-KLH, expressed as a proportion of initial antibody activity, in juvenile mink dosed with DE-71.

Chronic exposure to DE-71 at environmental levels resulted slight alterations to the innate immune system in terms of blood cell distribution. The ability to mount a normal antibody response was altered reduced in animals fed 0.5 DE-71. PBDE at 0.5 ppm may alter thymic function in developing mink. Development of germinal centers in spleen suggests juvenile and adult mink exposed to DE-71 may be overreacting in mounting an immune response. Inappropriate immune responses may be costly energetically – a more crucial concern in wild mink.